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(71) Applicant: Roberts, Graham Steed
Turret House 24 Church Street
Camberley Surrey(GB)

(71) Applicant: Smith, David Trevor
"Rudwicks", Rudwicks Close Felpham
Bognor Regis Sussex(GB)

(71) Applicant: Woolsey, Brian John
"Sunnyside", Surbiton Golf Course Woodstock Lane
South Chessington Surrey(GB)

(72) Inventor: Roberts, Graham Steed
Turret House 24 Church Street
Camberley Surrey(GB)

(72) Inventor: Smith, David Trevor
"Rudwicks", Rudwicks Close Felpham
Bognor Regis Sussex(GB)

(72) Inventor: Woolsey, Brian John
"Sunnyside", Surbiton Golf Course Woodstock Lane
South Chessington Surrey(GB)

(74) Representative: Silverman, Warren et al,
HASELTINE LAKE & CO. Hazlitt House 28 Southampton
Buildings Chancery Lane
London WC2A 1AT(GB)

(54) Modular wall and ceiling system.

(57) A wall and ceiling construction system for use in the construction of rooms which can be kept in a sterile and dust free state comprises wall panels (1) having a double skin (1a, 1b) construction with an air space between opposite skins thereof, the panels being secured together at upstanding marginal regions, possibly with the interposition of fixing posts. The panels include a number of panels which have at least one duct inlet (2) thereinto for communicating the room interior via the interior of the panels with extraction ducts above ceiling level at air outlet spigots (3). The panels are coved at their transition between the walls (1a, 1b) and a base (4) of greater width than the thickness of the panel. Depending upon the manner of provision of the duct inlets, in addition to achieving conventional air flow into floor level air inlets directly within the room, it is possible to achieve horizontal air flow or vertical air flow within the room.

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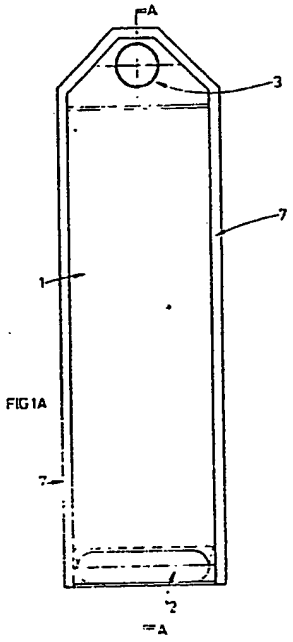

FIG1A

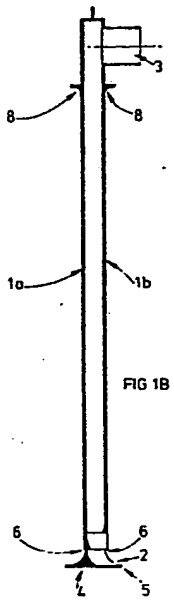

FIG 1B

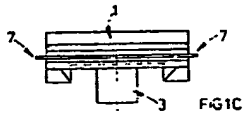

FIG1C

"MODULAR WALL AND CEILING SYSTEM"

This invention relates to a modular wall and ceiling construction system for use in the construction of rooms which can readily be rendered sterile and dust free and kept sterile and dust free and are accordingly suitable for use in those fields in which requirements exist for such conditions, in particular in the pharmaceutical, electronic, biochemical, chemical, atomic energy, food processing, optics, aerospace, photographic and dairy industries as well as in the medical sphere and in hospitals, for example in operating theatres.

According to the present invention, there is provided, for forming a room construction, a plurality of ceiling panels and a plurality of integrally moulded rigid wall panels having a double skin construction with an air space between opposite skins thereof, which panels are intended to be secured together at upstanding marginal regions, there being included among the wall panels a plurality of panels each having at least one duct inlet thereinto for communicating the room interior via the interior of the panels with extraction ducts above ceiling level, which panels are coved at their base edges to provide a rounded surface transition from wall to floor within the room.

In addition to separating one room or area from another, the wall panels for forming a room construction of the invention enable, as a result of their double skin construction, air to be extracted from within the room to

air extraction ducting above ceiling level allowing for possible recirculation to the room in a closed system incorporating appropriate filters. The room construction will include one or more panels or uprights having provision for the fitting of doors whose frames can optionally be entirely above the coving level so that the smooth wall to floor transition is maintained at all points around the room. Some of the wall panels can be of modified construction, similar to window constructions, to enable knock-out emergency exit panels to be fitted therein.

In practice, it will be the majority if not all of the panels not provided with such fittings as doors or knock-out panels which will provide the aforementioned air circulation facility. For this purpose, they will usually have an air intake duct at floor level for extraction of air and dust in the room at the position where dust concentration is likely to be most intense. The air extraction duct from above the ceiling can optionally be coupled to a common air conditioning or heating and ventilating duct or can be linked to independent air conditioning or heating and ventilation plants for each of the rooms created by the panelling.

The type of air flow achievable with a room construction embodying the invention may be of one of three types:-

1. Conventional air flow where air is fed into the room through a filter in the ceiling thereof and removed from the room at air extract ducts as aforesaid positioned at floor level.
2. Horizontal air flow, where air passes unidirectionally across the room via a bank of filters in one wall to a wall face on the opposite side of the room made up of perforated wall panels.
3. Vertical air flow wherein air is admitted through a ceiling filter bank. A perforated false floor with a coved transition occurring between it and the wall panels is positioned in the room space above floor level. Air entering the room

passes downwardly through the performations in the false floor into a sub-floor area to enter air intake ducts as aforesaid at sub-floor level and to pass up through the double skinned wall panels to above ceiling level to be returned to a fan.

The individual wall units may either be bolted directly to one another or supported by a combination of vertical posts fixed to the floor on a grid spacing with support brackets rigidly fixing panel unit to adjacent panel unit. Such vertical posts are hidden behind service panels which are likewise coved at their transition to the floor and ceiling. The service panels provide the service of connecting the profiles of the main panels either side and allow mechanical/electrical services to be brought down (or up) to the room.

Although all of the wall panels with the exception of those which have provision for doors or knock-out panels may include air intake ducts, these will generally be provided at only one skin. The panels can accordingly be handed which allows a single wall panel thickness of wall to be provided between adjacent rooms in a multi-room construction with the facility for air extraction being provided in each room to individual or common duct systems by handing of the panels so that for example alternate main wall panels provide extraction facility from one room with the intermediate panels facing the other way providing a like facility in the adjacent room.

For a better understanding of the invention and to show how the same can be carried into effect, reference will now be made, by way of example only, to the accompanying drawings wherein:

FIGURES 1A, 1B and 1C respectively show in elevation, vertical cross-section and plan view one form of wall panel incorporating a floor level air extracting duct for use in forming a room construction embodying the invention;

FIGURES 2A and 2B are an elevation with parts cut away and a vertical cross section through a modification of the

panel of Figure 1, provided with a security filter;

FIGURES 3A and 3B are an elevation of and a vertical cross-section through a third form of panel having provision for horizontal unidirectional air flow extraction.

FIGURES 4A, 4B and 4C are respectively an elevation, a vertical cross-section through and a plan view of a panel of the type shown in Figures 3A and 3B incorporating additionally a security filter;

FIGURES 5A, 5B and 5C are respectively an elevation, a vertical cross-section through and a plan view of a blank wall panel which can optionally include piped and cable services;

FIGURES 6A and 6B are respectively an elevation of and a vertical cross-section through a wall panel embodying the invention incorporating am emergency exit from the room of which the panel forms a wall part and

FIGURES 6C and 6D are details to a larger scale of features shown in Figure 6B;

FIGURE 7A is an elevation of a panel incorporating a viewing window and FIGURE 7B shows in vertical cross-section, the viewing window;

FIGURES 8A and 8B are respectively an elevation of and a vertical cross-section through an alternative form of window construction to that shown in Figure 7B;

FIGURES 9 and 10 are perspective views of alternative forms of corner panels which enable between them most forms of room shape to be accommodated;

FIGURES 11A and 11B are respectively an elevation of and a vertical cross-section through a services panel which links one mainpanel face to another;

FIGURE 12 is a plan view of a corner region of a room construction embodying the invention and showing standard dimensioned wall panels used in the room construction;

FIGURES 13A, 13B, and FIGURES 13C and 13D show in elevation and transverse cross-section typical door constructions for inclusion in a room construction embodying the invention;

FIGURE 14 shows in perspective view from above ceiling elements of the room construction;

FIGURES 15A and 15B are vertical sections at right angles to one another through the ceiling panels at their position of connection to roof girders of a building in which the room construction is set up;

FIGURE 16 is a perspective view of a triple room construction embodying the invention in a corner region common to the three rooms;

FIGURE 17 is a perspective view of a multi-room construction embodying the invention; and

FIGURES 18A, 18B and 18C show schematically respectively conventional air flow, horizontal air flow and vertical air flow achieved in room constructions embodying this invention.

In various of the foregoing figures, vertical sections shown in B figures are taken through the corresponding A figures at A-A.

Referring to Figures 1A to 1C of the drawings, there is shown what may be termed a basic wall panel 1 for a room construction embodying the invention. In order that a modular system should be built up incorporating such wall panels, all elements of the room construction will have dimensions which are the same, a whole number multiple or a fraction thereof. Thus it is envisaged that the wall panel of Figures 1A to 1C will have a width of 1000 mm. The wall panel is of double skin construction and is preferably moulded from glass reinforced polyester which has the advantageous qualities for the aforementioned uses of lightness, strength, durability, chemical resistance and reproducible finish. The panel has opposed skins 1a and 1b (see Figure 1B). The wall panel is a closed element but for the provision of an air duct opening 2 at floor level and an air extract spigot 3 above ceiling level. The main wall surfaces 1a and 1b are coved at their transition to a base 4 of greater width than the thickness of the panel. The coves are stepped at 5 above the base floor to enable a floor screed to finish flush with the horizontal face of the cove allowing sheet, painted or tile floor finishes to be accommodated. The walls are stepped forward from

the vertical face of the cove at 6 to allow a flooring material such as sheet, trowelled or painted flooring to be applied continuously up the curved surfaces to the wall step to finish flush with the wall face of the panel. Lugs 7 (see Figures 1A and 1C) are formed integrally with the side skins of the panel to provide means for the fixing of the panels to support posts or to adjacent panels as will be described hereinafter. Coves 8 are moulded at ceiling level into the main skins of the panels to provide a smooth transition from wall to ceiling. The wall panel extraction air outlet spigot 3 is moulded into one main panel skin (the choice is immaterial) above ceiling level.

Referring to Figures 2A and 2B in which like reference numerals represent like parts in Figures 1A to 1C, a panel of fundamentally like construction to that shown in Figures 1A to 1C incorporates in addition in the interior thereof just above the wall panel air duct inlet 2 a filter frame 9 carrying a security filter 10. The filter is accessed for renewal via the air duct opening 2 and is held and sealed against the filter frame mechanically (not shown).

Referring next to Figures 3A and 3B in which again like reference numerals represent like parts in Figures 1A to 1C, a wall panel 100 for use in a room construction embodying the invention but which is to be employed in a unidirectional horizontal air flow system through the room comprises one main skin 11 which is formed with a plurality of perforations over its surface area. These perforations may also be included in a skin 12 which lies across the air intake duct inlet 2. With such a construction, air can be drawn from the room into the wall panel duct evenly over the whole face of the perforated skin. As an alternative to forming the perforated skin integral with the remainder of the panel, it may be convenient for the panel to be formed without such skin and for a separately formed element to be connected as a second main skin to the remainder of the panel by adhesive bonding or the like.

Figures 4A and 4B show an alternative position for accommodating a security filter to that shown in Figures 2A and 2B, the security filter here being an element 13 provided on flange element 14 attached to the air extract spigot 3 above ceiling level. Such a position of air security filter is applicable to the panel constructions of Figures 1A to 1C and 3A and 3B and is of particular value with the panel construction of Figures 3A and 3B because of the provision of the perforated skin section 13 at the position of the security filter of Figure 2.

It is not essential for all of the standard size wall panels of the room construction embodying the invention to include provision for air circulation therethrough. Thus referring to Figure 5, there is shown a wall panel 200 which apart from the absence of an air extraction spigot is dimensioned overall similarly to a panel of the preceding figures. However an air intake duct is absent from a lower region so that an opposed pair of completely coved base portions 15 is provided. To provide a measure of heat insulation, for temperature controlled rooms and other specific applications, the interior of the panel is filled or lined with suitable insulation material.

In order to comply with statutory regulations concerning fire and for other hazards personal escape routes using emergency exits within such rooms are required. Figures 6A and 6B show a personal emergency exit "knock out" panel 17 built into one of the wall panel skins 1a of a panel 300. The other wall panel skin 1b incorporates a cutaway section 18 to provide clear access once the knock out panel has been removed. The emergency exit "knock out" panel is held and sealed into the wall panel skin 1a with a rubber gromet 19 (Figure 6C). The rubber gromet overlaps the joint seal on each side of the panel at a handle position 20 (Figure 6A) so creating a tab handle 21 on one or either side of the "knock out" panel 17 (see the enlarged scale view 56 table handle 21 in Figure 6D) on which a handle 22 is affixed. Access through the panel can be achieved in an emergency

from either side by pulling the tab handle 21 on the appropriate side so stripping the gromet from the wall panel and "knock out" panel 17 thereby allowing the emergency exit panel to be pushed out. The provision of the tab handles on both sides and the provision of see-through windows of which the panel 17 may be one make it possible for either the person working in the room to escape or for rescuing personnel to reach him.

A viewing facility into the room can be provided in ways additional to those envisaged in connection with Figure 6A. For example a conventional panel, that is having air flow therethrough may nevertheless have a viewing window to enable occupants outside a room to view activities in the room. Thus referring to Figure 7A, a panel 400 of like format to that shown in Figures 1A to 1C has additionally a glazed portion 23 in each of the main skins in direct line across the panel cavity. Referring specifically to Figure 7B which is a section through Figure 7A at B-B, the glazed panels 23 can be seen to be held into the wall panel with rubber gromets 24. As an alternative to this holding arrangement, in Figure 8A and Figure 8B (a section through Figure 8A at C-C, glazing panels 23 are held in rebates 25 moulded into each of the panel skins by means of adhesive 26 applied to the rebates.

As previously indicated, the integral lugs 7 on all wall panels of a room construction embodying the invention play a part in enabling a room construction to be formed utilising the wall panels. Thus referring to Figure 9, a vertical internal corner piece 500 enables two wall panels at right angles to each other to be connected and at the same time provides a smooth transition around the corner both at floor and wall level. The corner piece 500 comprises two main walls 27 and 28 at right angles to each other which nestle into the right angle formed between the lugs 7 and the wall skins of the panels from which they project. The corner piece has a similar profile to the wall skins for which it is to provide a continuous surface, including concave rounding in the region where the walls 27 and 28 come together (coving 29) and

coving 30 in a base region for providing the aforementioned smooth transition both from wall to wall and from wall to floor. Integrally mouled with the corner piece in an upper region thereof are sections of corner cove 31. The corner piece is bonded and sealed to the wall units.

The corner unit of Figure 9 provides a neat finish within a room. If a corner position is common to two or more rooms then an appropriate number of corner pieces 500 will be employed, one corner piece being employed between each two wall skins at right angles to each other. Where wall skins are external to a plurality of room constructions embodying the invention, then two types of filler elements are proposed for providing a neat appearance on the exterior of the room assembly. Thus Figure 10 shows an external corner piece which is to be employed where only two wall panels embodying the invention come together and are given a smooth connection within the room by a corner piece 500 of Figure 9. The corner piece 600 of Figure 10 maintains an identical profile to the wall panels and utilises the lugs 7 on the sides of the wall panel for its location. A cove 33 is moulded into an upper region of the panel to be continuous with coving 8 on the outside of the exterior skin 1a of the wall panel and coving 34 is provided around the two sides 35 of the corner piece. The corner piece is bonded and sealed into the wall panel unit.

Where there is a T-junction between walls of adjacent rooms, then use will be made of two corner sections of the type shown in Figure 9 within the room and a flat service panel 700, generally 200 mm wide as shown in Figures 11A and 11B. This maintains the basic profile of the panels, although extending up to ceiling level only, and includes a coved portion 36 at the base thereof and a cove 37 which are intended to be continuous with coves of adjacent wall panels. These service panels can also be employed to box in support posts (see Figure 16) to be positioned between panels assembled in a straight line. The service panels 700 are fixed in place with simple mechanical locators and subsequently the joint is sealed.

Service supplies to the room can be fed behind the service panels to terminate within the rooms for onward connection to equipment used within the rooms. The service panels are split at the base 36 so that the main part 700 may be removed conveniently during the life of the room to allow additional services to be installed as required.

Referring next to Figure 12 there is shown in plan view a typical assembly of panels embodying the invention, together with appropriate corner pieces and service panels. The panels shown can be of the type shown in Figure 1 and there are shown in combination corner pieces 500 and 600 of Figures 9 and 10 respectively with additional support being provided by a corner post 38 to which the lugs 7 of the panels are bolted. Service panels 700 of Figure 11 are shown at two positions. Firstly they are shown at a position at which adjacent panels are connected together at upstanding slotted members 39 into the slots of which the lugs 7 of the panels engage. These fixing elements are an alternative to the fixing posts to be described hereinafter with reference to Figure 15. The alternative use of the service panels 700 is in the formation of a door jamb 40 (see hereinafter with reference to Figures 13A to 13D).

Figure 12 is also useful in showing how a single wall formed of panels embodying the invention may be used in the extraction of air from adjacent rooms. This is made possible merely by the alternate handing of panels in a run thereof.

Referring next to Figures 13A and 13B, a single door 42 is shown to be incorporated into a main panel 800, typically a panel of the type shown in Figure 5.

A subframe 41 is incorporated inside the panel 800 allowing the door hinges 43 to be secured through the panel door jamb. Most door and hinge types can be accommodated (including rebated door jambs) in this manner. The base of the door jamb is coved at 45 in a similar fashion to the coving 5 of the main panel 800.

Figures 13C and 13D illustrate how a double door arrangement is accommodated by the combination of two modified main panels 900 and a shortened service panel 1000. Analogous constructional features to those shown associated with door 42, in particular, hinges 43 and sub-frame 41 (see Figure 13A) are incorporated in the double door of Figures 13C and D.

Referring to Figure 14, a ceiling construction for rooms constructed according to the invention may be made up from a plurality of ceiling units 46 having for example the standard module dimension of 1200 mm of the panels and extending wall to wall. The panels 46 are channel shaped in cross-section, having flanges 47 providing surfaces for connecting one panel to another with mechanical fixings, adhesive or sealant 48 (Figure 15B). As can be seen particularly well from Figures 15A and 15B, the flanges 47 also act as brackets for the support of the ceiling below a permanent feature of the building in which the room construction is formed. For example roofing girders 49 of the type shown in Figure 14 may be formed with flanges 50 through bores in which pass hook bolts 51 entering appropriate openings in the flanges 47 of the panels. At wall junctions, the ceiling panels are bonded and sealed to the ceiling coves. Light fittings and filter housings may be fitted to and bonded into the ceiling panels 46 in appropriate manner (not shown).

A fuller overall appreciation of the manner in which multiple room structures can be built up embodying the invention from panels as aforesaid will be best appreciated by reference to Figures 16 and 17 in which like reference numerals denote like parts in the preceding Figures.

For the purposes of simplicity, it may be assumed in Figure 16 that the wall panels given the letters H to R are all of the type shown in Figures 1A to 1C, the panels being supported on posts 53 clad in service panels 700. Each panel is provided with a floor level air duct opening 2 with adjacent panels being oppositely handed so that overall provision is made along the length of one wall for air to be extracted therethrough from the two rooms which it

separates. A proprietory floor finish such as vinyl sheeting 52 lies on the floor above screeding and enters into and around the openings to the openings 2. Depicted in Figure 16 are three rooms A, B and C divided by the walls made up of panels H to R. Air is extracted from room A via floor level openings 2 to respective outlet ducts at spigots 3 from which it is connected into the main heating and ventilating or air conditioning duct work. Ducts in panels P, Q and R serve room A. Air from room B is extracted in independent duct panels L, M and N and air from room C is extracted in independent duct panels H, J and K. In the interests of clarity the ceiling panels are not shown, although the ceiling coves 32 are shown.

Figure 17 shows a multi-room construction in which wall panels as aforesaid are employed to construct six rooms A to F arranged with rooms A to C on one side of a corridor 54 and the rooms D to F on the other side. The corridor is divided up by double doors ,44 of the type shown in Figures 13C and 13D at the position of room dividing walls 55 and 56. A door 42 of standard unit width communicates rooms A and B. Room A is shown to have provision for uni-directional horizontal air flow therewithin, incorporating panels of the type shown in Figures 3A and 3B. Room E shows the arrangement of ceiling panels 46 and a roof girder construction 58 can be seen to be extending above ceiling level through room D. Viewing windows 23 are shown in some of the wall panels of room E.

Referring finally to Figures 18A, 18B and 18C, the diagrammatic air flow through rooms constructed according to the invention can be seen. In each case a fan 59 is shown. This will not normally be placed above the room but at a central position to which extend duct work from individual panels and rooms and from which extends duct work back to the rooms. Filters 60 are provided at ceiling level (Figure 18A or Figure 18C) or as a wall (Figure 18B). Arrows denote the direction of air flow in each case. In Figure 18A air flow is through ceiling mounted filters

60 into the room and out thereof through air duct openings 2 at floor level, up through the wall panels and back to the fan 59. In Figure 18B, opposite walls 60 and 61 are provided for horizontal air flow therethrough. Entry walls 60 are filter banks. Finally in Figure 18C, above the base floor 62 of the room is provided an intermediate grill floor 63 formed with small openings (not shown). This is the operative floor of the room above which all normal activity will take place. Air enters the room through a filter bank 64 occupying the entire ceiling area, but passes vertically downwards through an intermediate floor grill to a sub-floor space from which it is drawn into the interior of the panels through air duct openings 2. The smooth floor to wall transition of Figures 1 and 2 maintained by the provision of coving between the upstanding wall surfaces 65 and the grill 63.

From the foregoing, it will be apparent that room constructions can be provided embodying the invention which may be of the sealed pressure type with smooth, crevice and ledge-free room surfaces. The room construction is primarily intended to serve the needs of industries, research and medicine where cleanliness and/or sterility or an intrinsic requirement for the operations to be performed within the rooms. The room constructions embodying the invention are nevertheless also suitable for use as temporary or semi-permanent rooms within buildings which may be employed where a high density of people is anticipated, such as theatre foyers, lecture theatres, conference rooms, dance halls, discotheques, where the ready provision of air flow ducting arrangement without the need for unsightly ducts to be visible can be provided quickly and relatively inexpensively.

Claims:

1. For forming a room construction, a plurality of ceiling panels and a plurality of integrally moulded rigid wall panels having a double skin construction with an air space between opposite skins (1a, 1b) thereof, which panels are to be secured together at upstanding marginal regions, there being included among the wall panels a plurality of panels each having at least one duct inlet (2) thereinto for communicating the room interior via the interior of the panels with extraction ducts above ceiling level, which panels are coved at their base edges (4) to provide a rounded surface transition from wall to floor within the room.

2. The plurality of panels of claim 1, wherein the wall panels are formed of glass reinforced plastics material.

3. The panels of claim 1 or 2, which comprise floor level air duct inlets (2).

4. The plurality of panels of any one of claims 1 to 3, wherein the wall panels are stepped (5) at their coves above the base floor to enable a floor screed to finish flush with the horizontal face of the cove and are stepped forward (6) from the vertical faces of the cove to allow a flooring system to be applied continuously up the coved surfaces to end flush with the wall face of the panels.

5. The plurality of panels claimed in any one of the preceding claims, the wall panels including panels having one upstanding wall surface (11) formed with a plurality of apertures disposed thereover for enabling horizontal air flow into the panels to take place across the room construction.

6. The plurality of panels according to any one of the preceding claims, wherein the wall panels incorporate therein a security filter (9,13).

7. The plurality of panels according to claim 6, wherein the security filter (13) is positioned within the duct inlet (2) of each said panel having a duct inlet.

8. The plurality of panels according to claim 6,

wherein the security filter is housed in an air outlet spigot (3) at an upper region thereof.

9. The plurality of panels according to any one of the preceding claims, further including at least one said wall panel modified to have a portion of one skin (1b) cut away and being provided in the opposite skin (1a) with an emergency knock out panel (17) held and sealed into the panel with means which permit the rapid removal of the panel (17) in an emergency.

10. The plurality of panels according to claim 9, wherein, for achieving ready removal of the knock out panel (17), a rubber gromet (20) which seals the knock out panel in its skin of the panel in which it is held overlaps a joint seal (19) on either side of the panel to create a tab handle (21) which on pulling causes the gromet (20) to be stripped from the wall panel and enable the knock out panel (17) to be removed.

11. The plurality of panels according to any one of the preceding claims, further including at least one wall panel (400) having a viewing window (23) sealingly set in each skin thereof.

12. The plurality of panels according to any one of the preceding claims , further including at least one said wall panel modified to exclude the provision of a duct inlet thereinto and completely coved at both laterally extending base edges (5).

13. The plurality of panels according to claim 12, wherein said at least one wall panel (200) is filled or lined with insulation material (16).

14. The plurality of panels according to any one of the preceding claims, wherein all said wall panels are formed at the ceiling level therein with an integral coving extending across each said skin thereof.

15. The plurality of panels according to any one of the preceding claims, in association with one or more corner pieces (500,600) for joining adjacent panels at corner positions and shaped to provide a surface continuous

with the panels which it joins at substantially all positions over the height thereof at least up to ceiling level.

16. A room construction which is formed of a plurality of panels as claimed in any one of the preceding claims and which additionally includes at one or more panel (800, 900) positions a door (42, 44).

17. A room construction according to any one of the preceding claims with the exception of claim 5 or any claim appended thereto, which comprises a lower floor (62) at which are positioned floor level air duct inlets (2) of said wall panels and which contains above said lower floor (62) a perforated false floor (63), with interposition of coving to provide a rounded transition thereto from the wall panels (65), whereby vertical air flow from ceiling to floor is able to take place within the room constructions.

18. A wall panel for use in the formation of a room construction, being a wall panel as defined in any one of the foregoing claims 1 to 15.

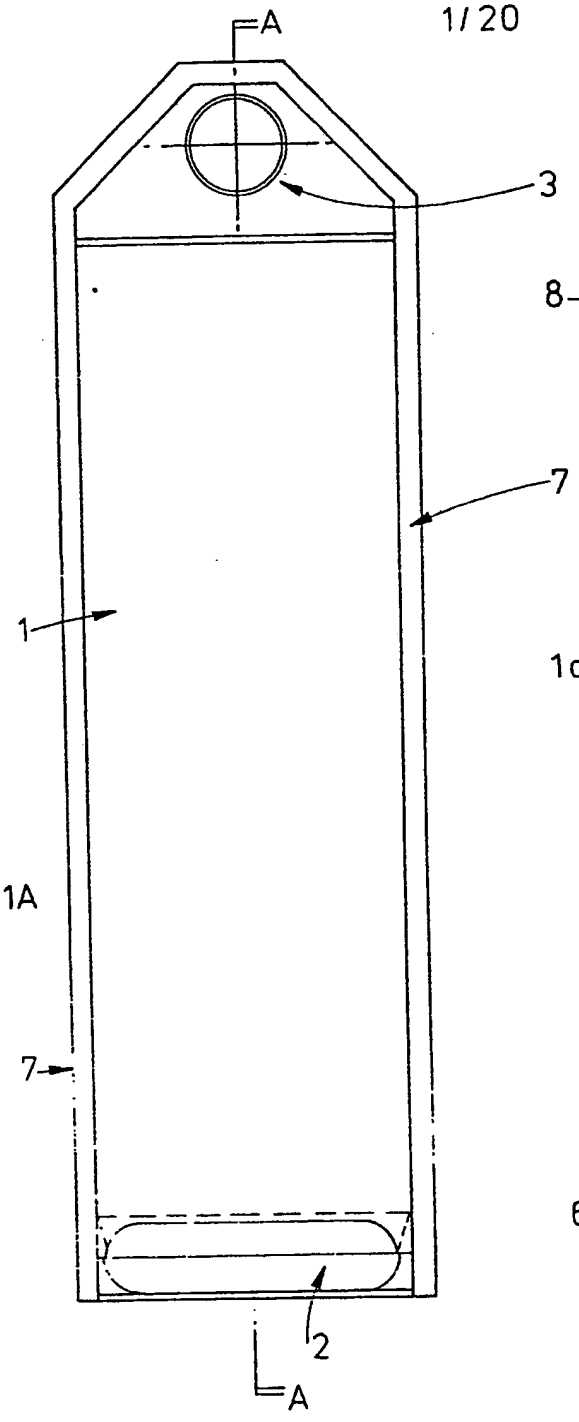

FIG1A

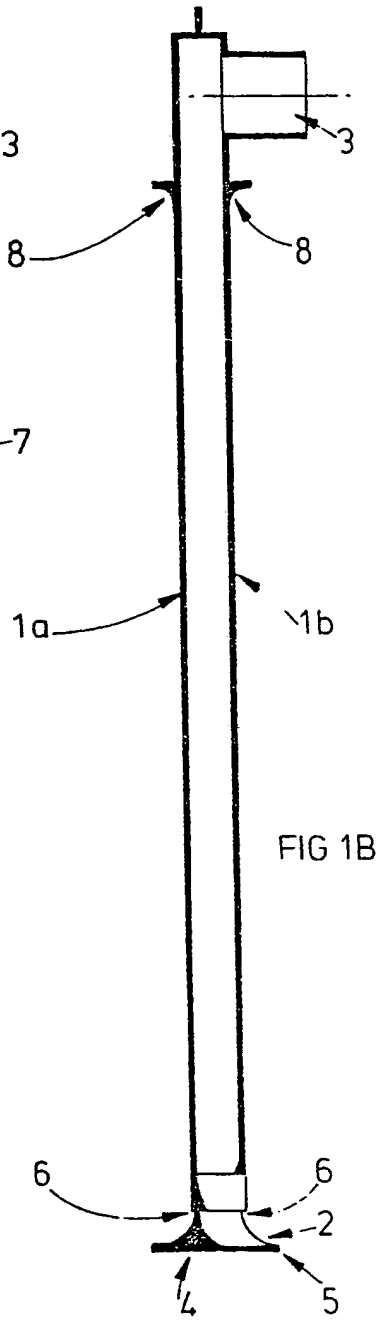

FIG 1B

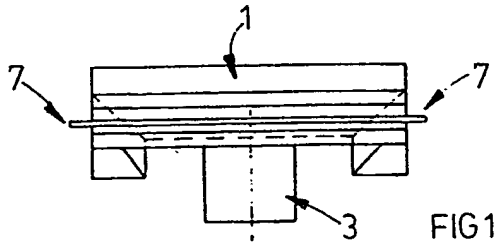

FIG1C

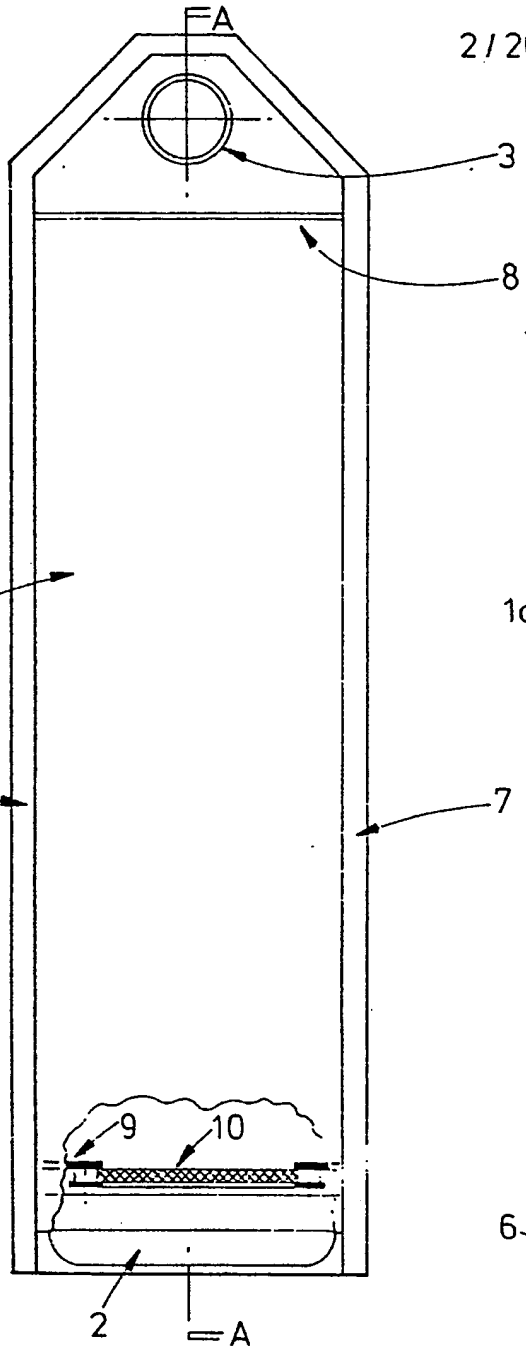

FIG 2A

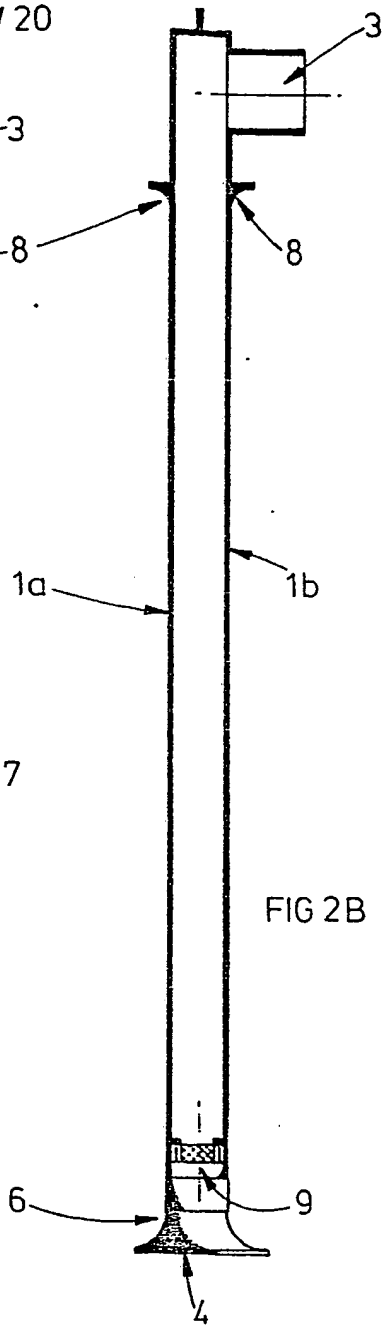

FIG 2B

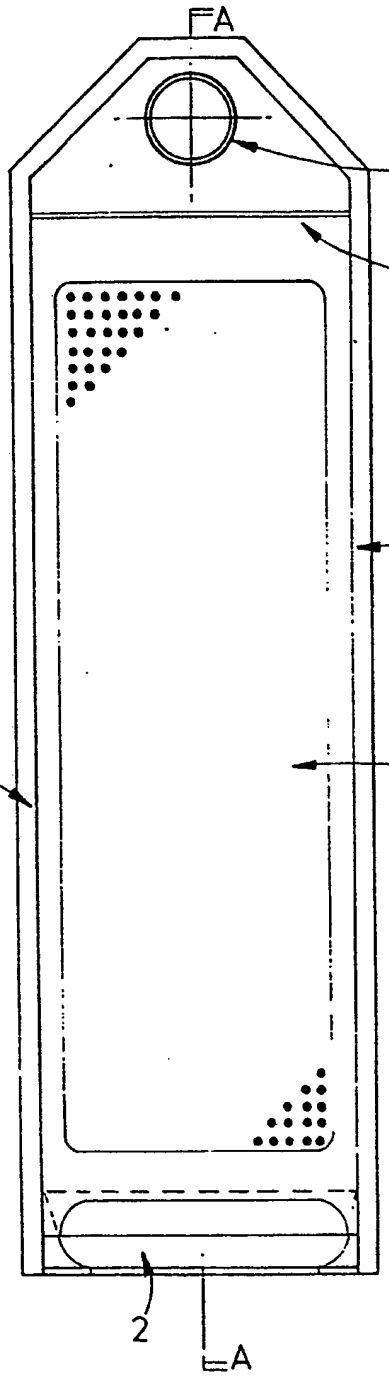

FIG 3A

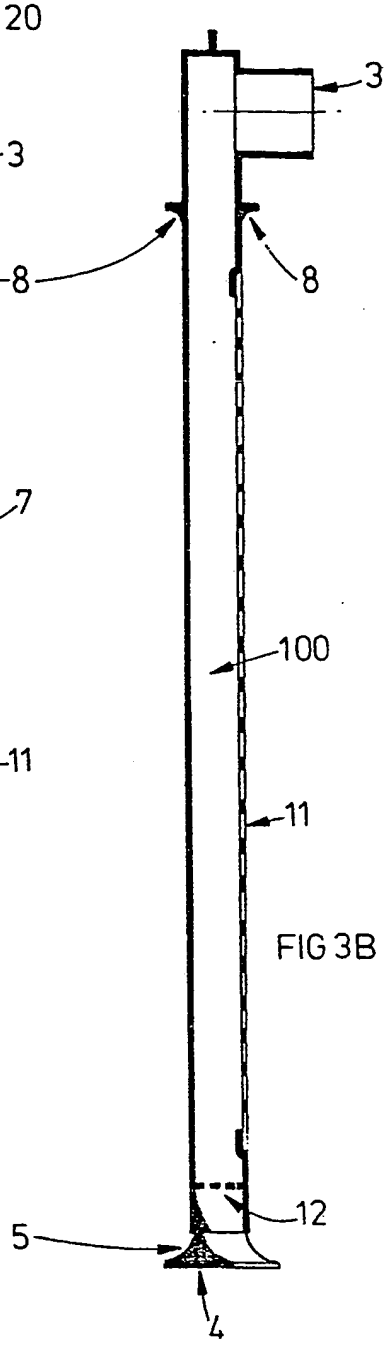

FIG 3B

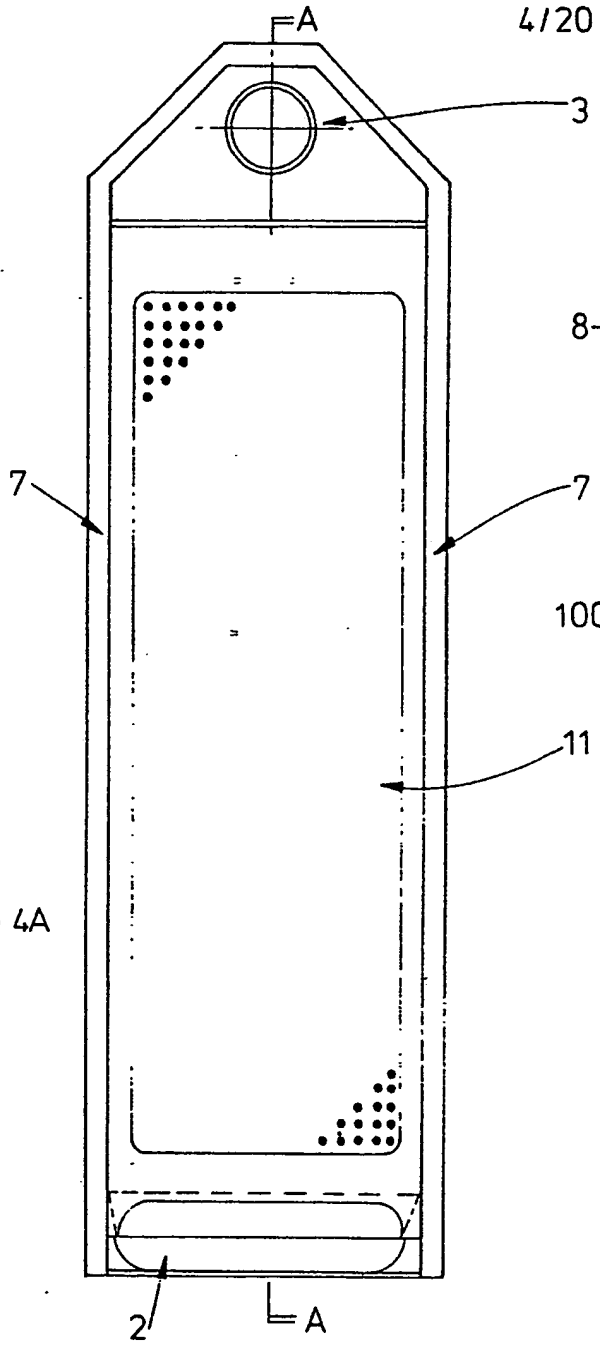

FIG 4A

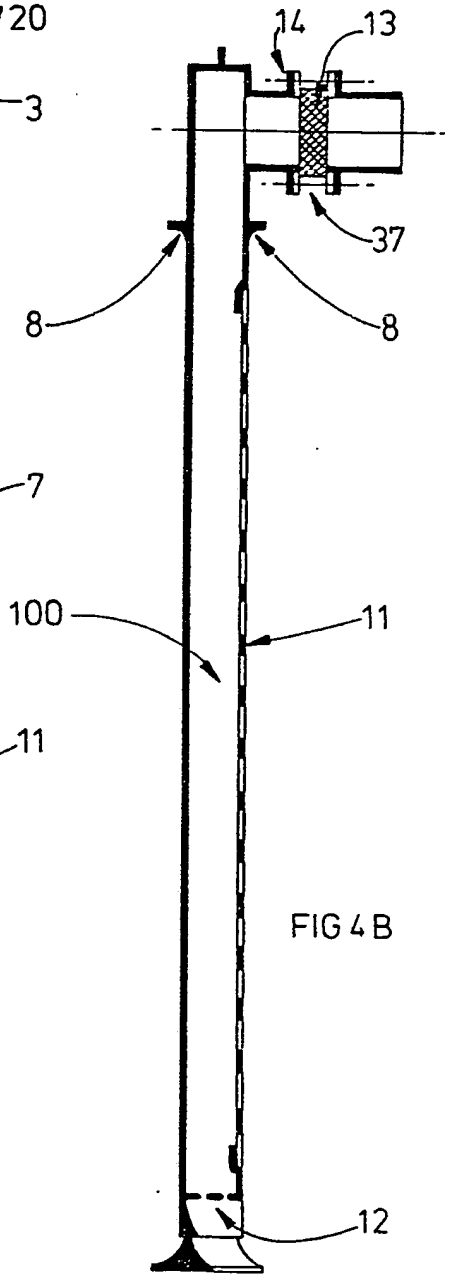

FIG 4B

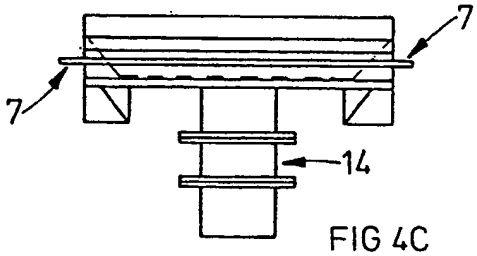

FIG 4C

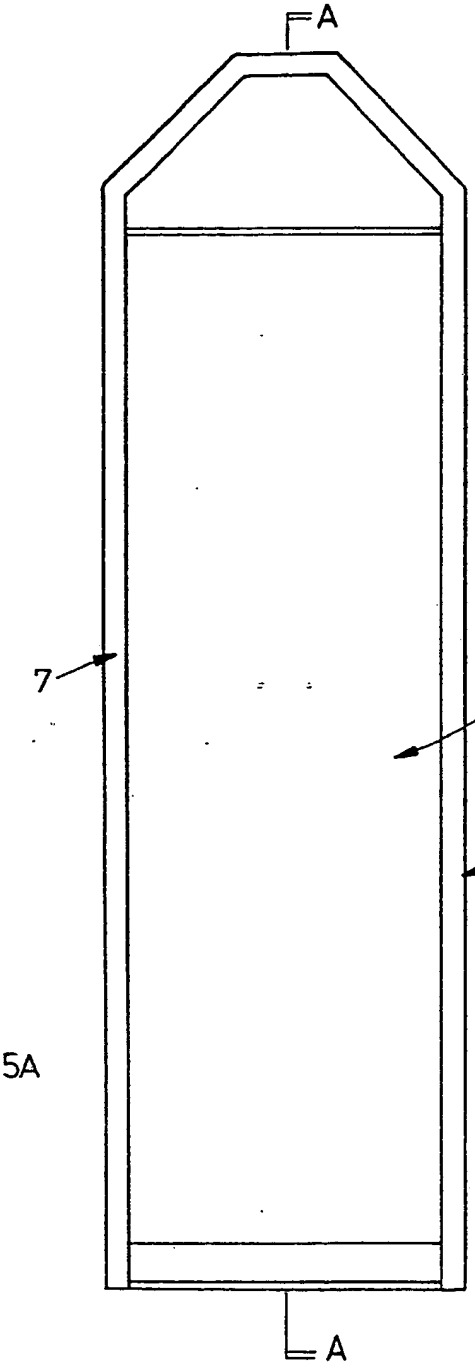

FIG 5A

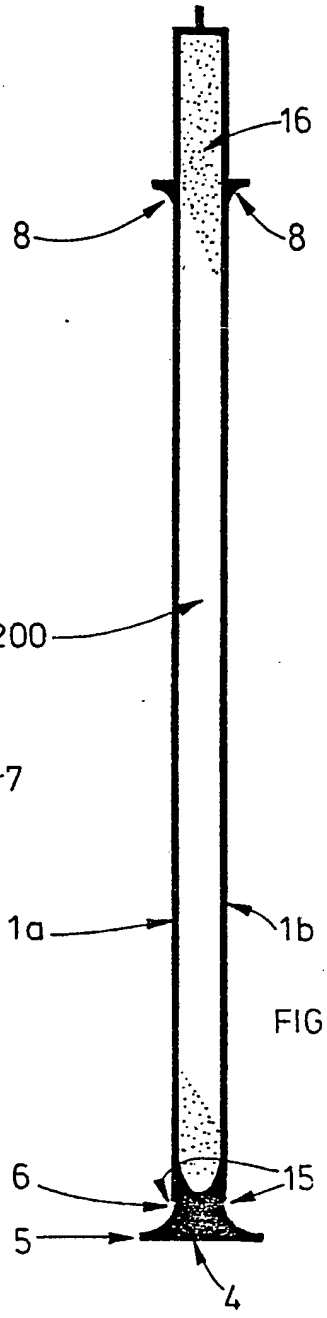

FIG 5B

FIG 5C

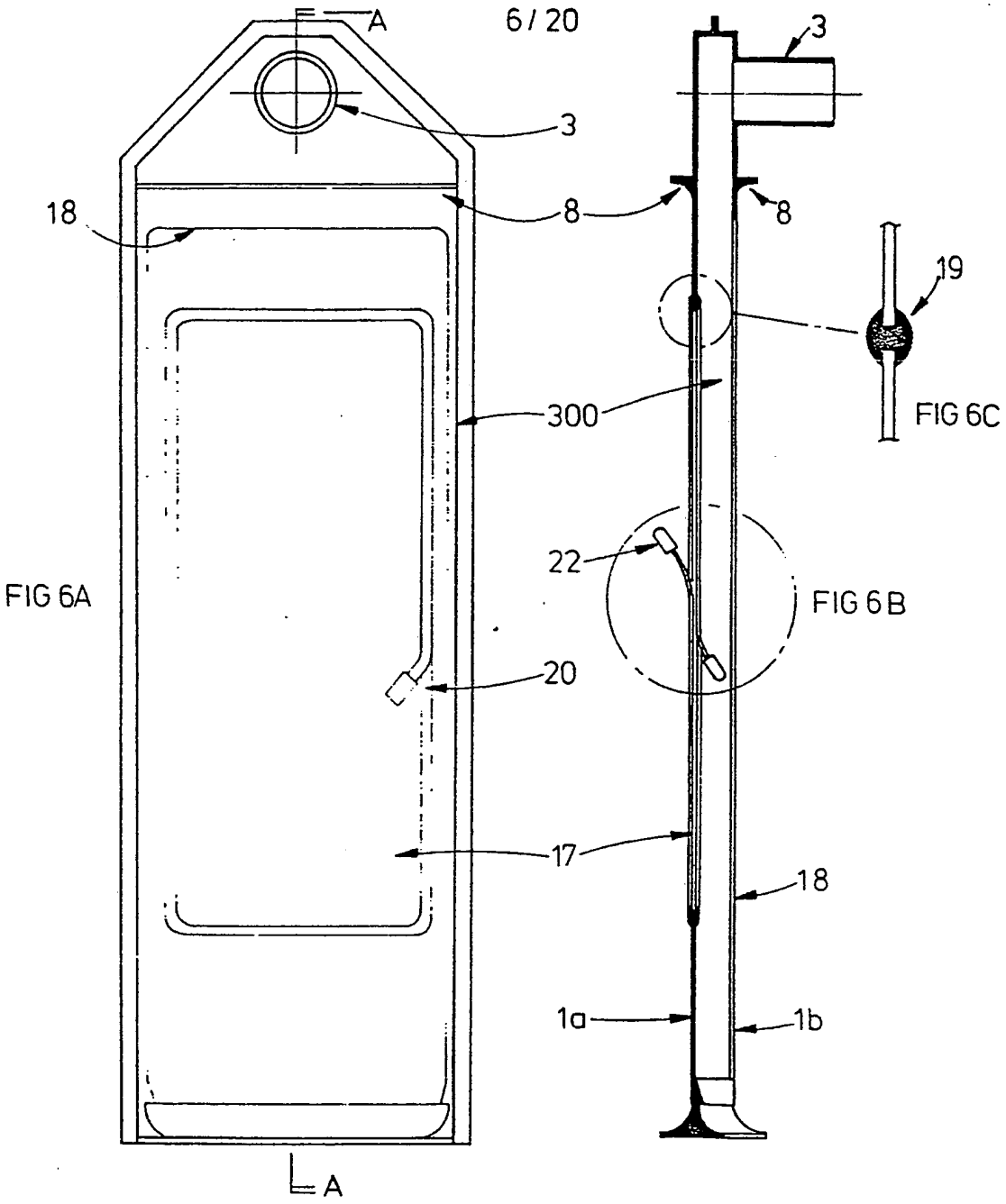

FIG 6A

FIG 6B

FIG 6C

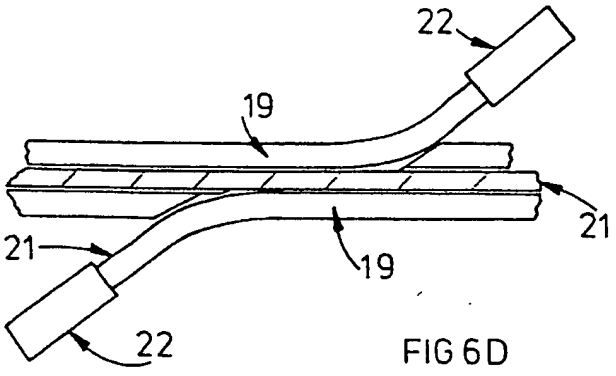

FIG 6D

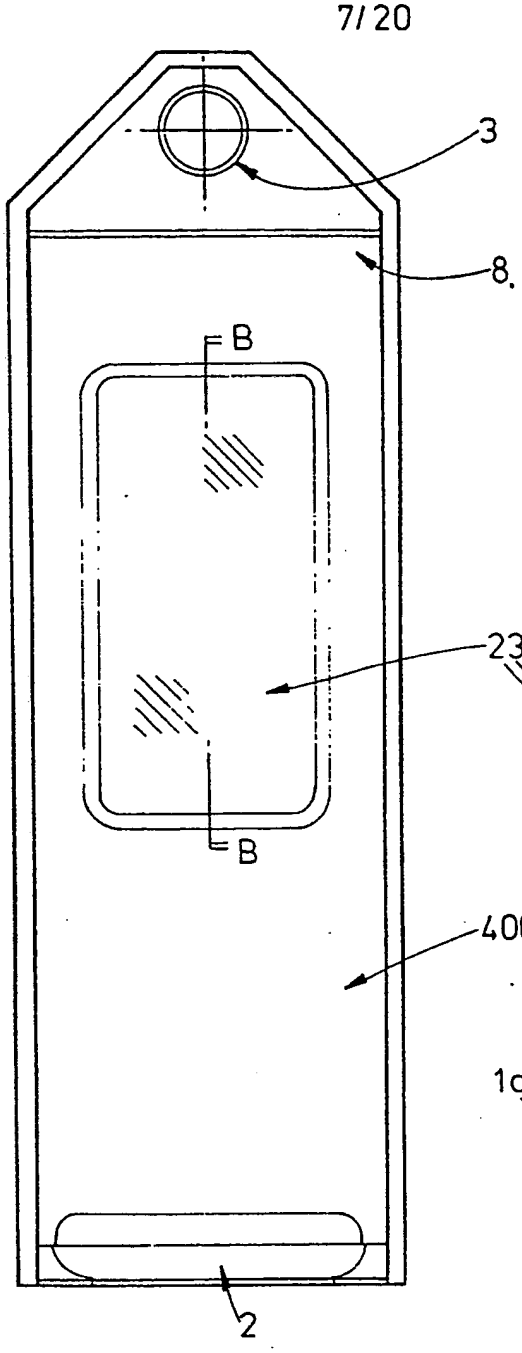

FIG 7A

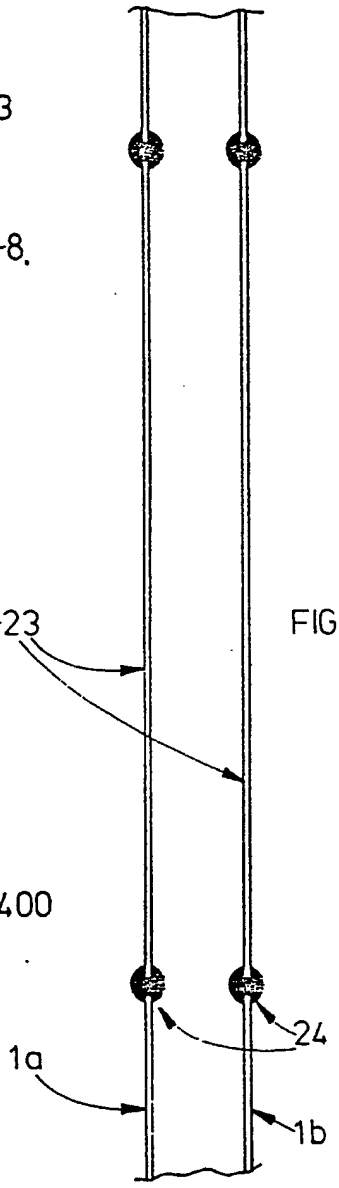

FIG 7B

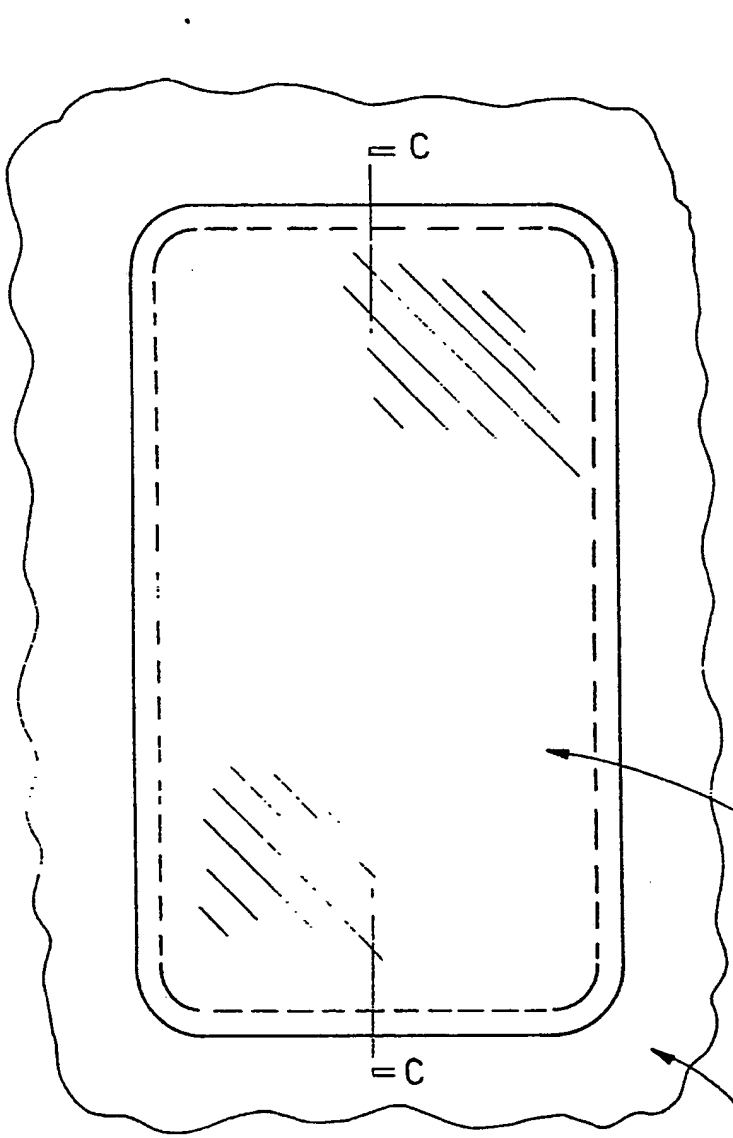

FIG 8A

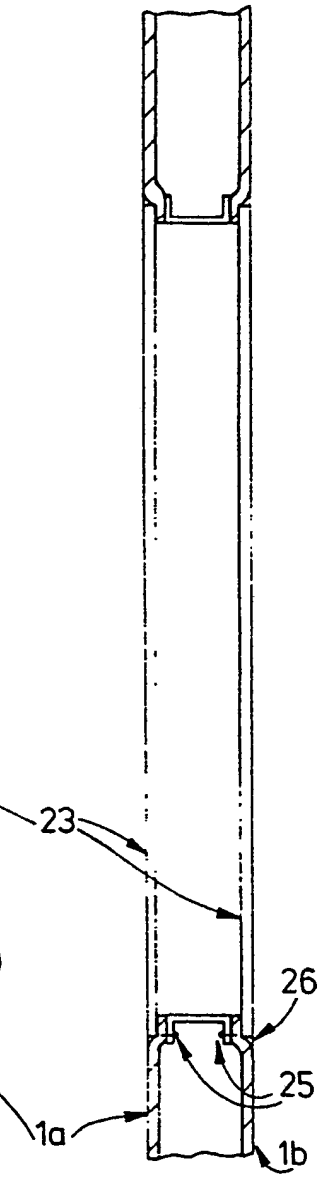

FIG 8B

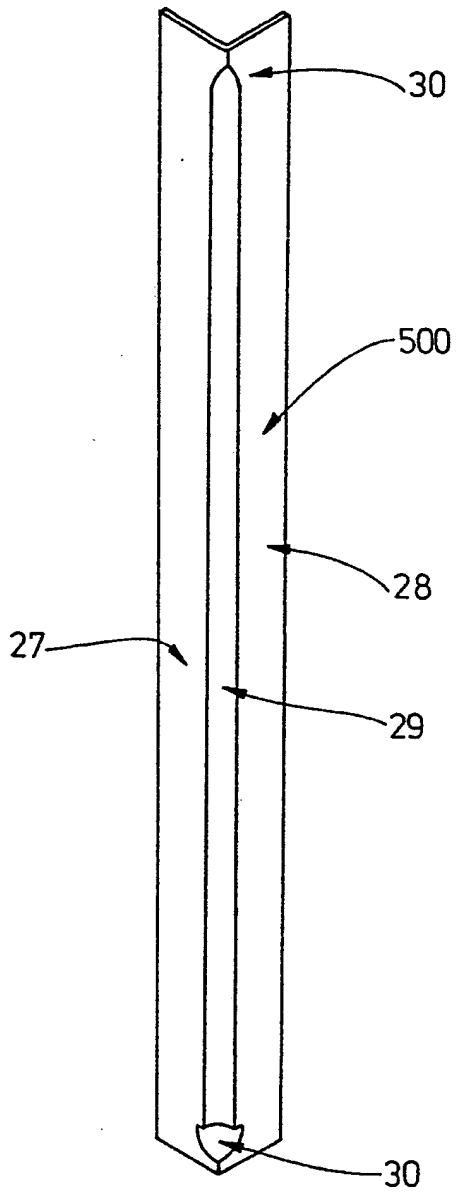

FIG 9

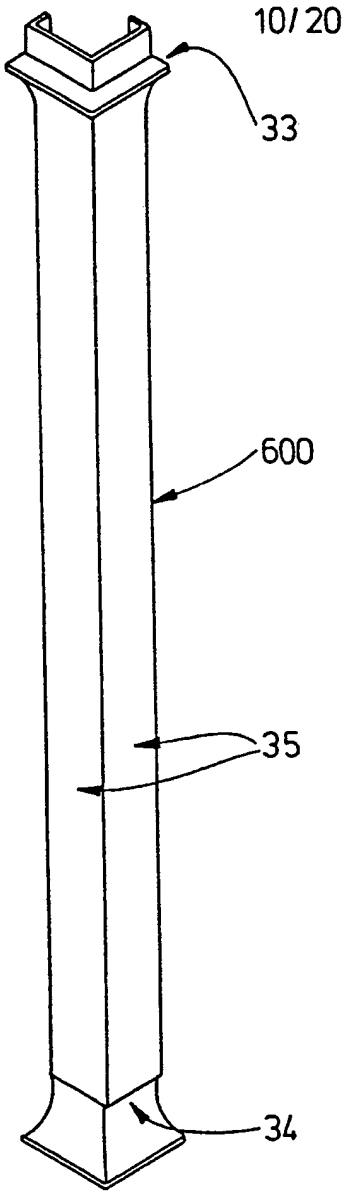

FIG 10

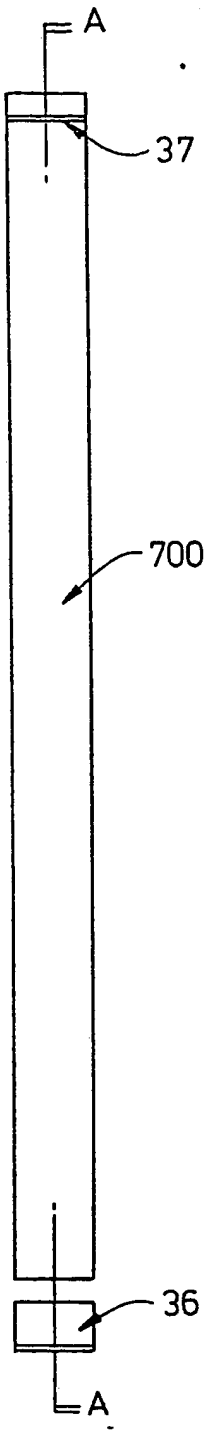

FIG 11A

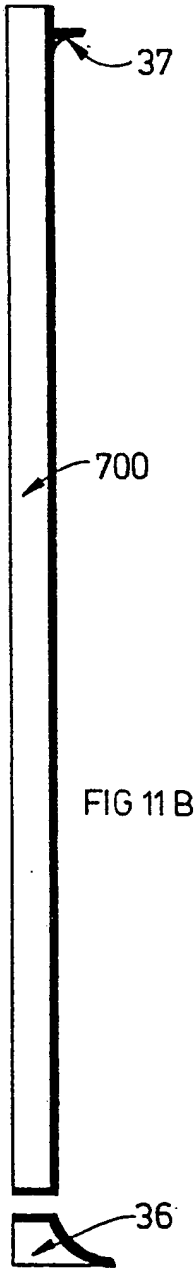

FIG 11B

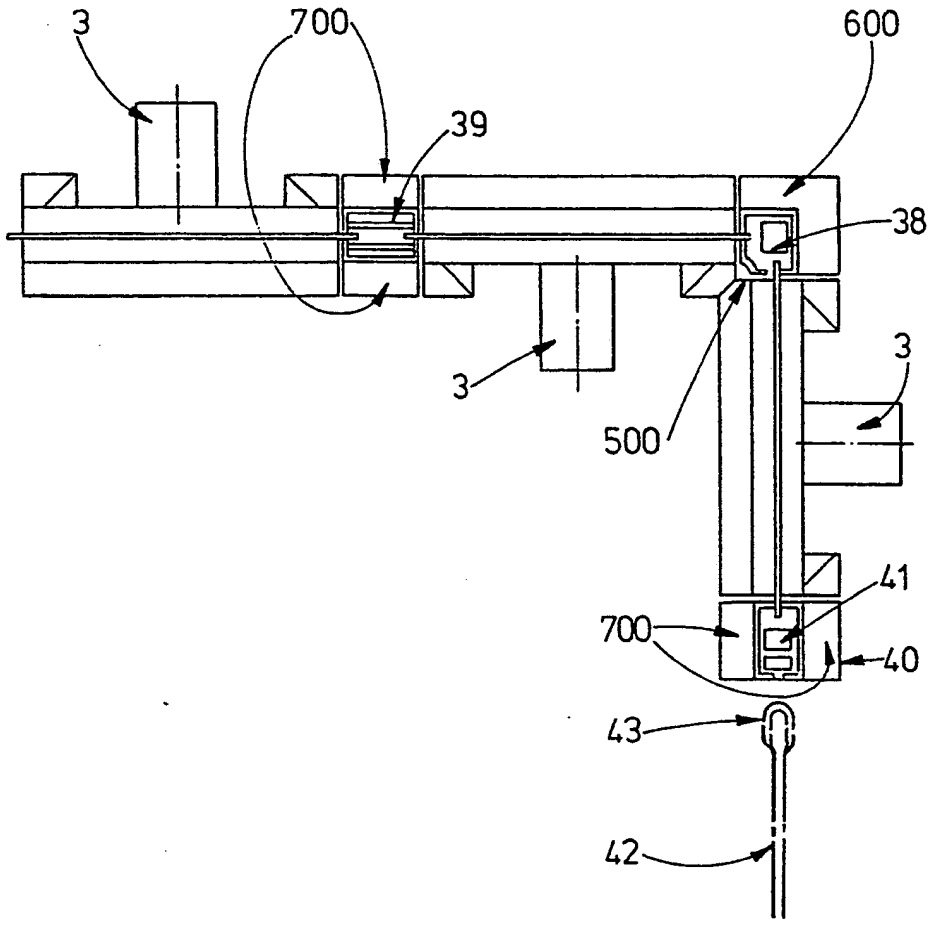

FIG 12

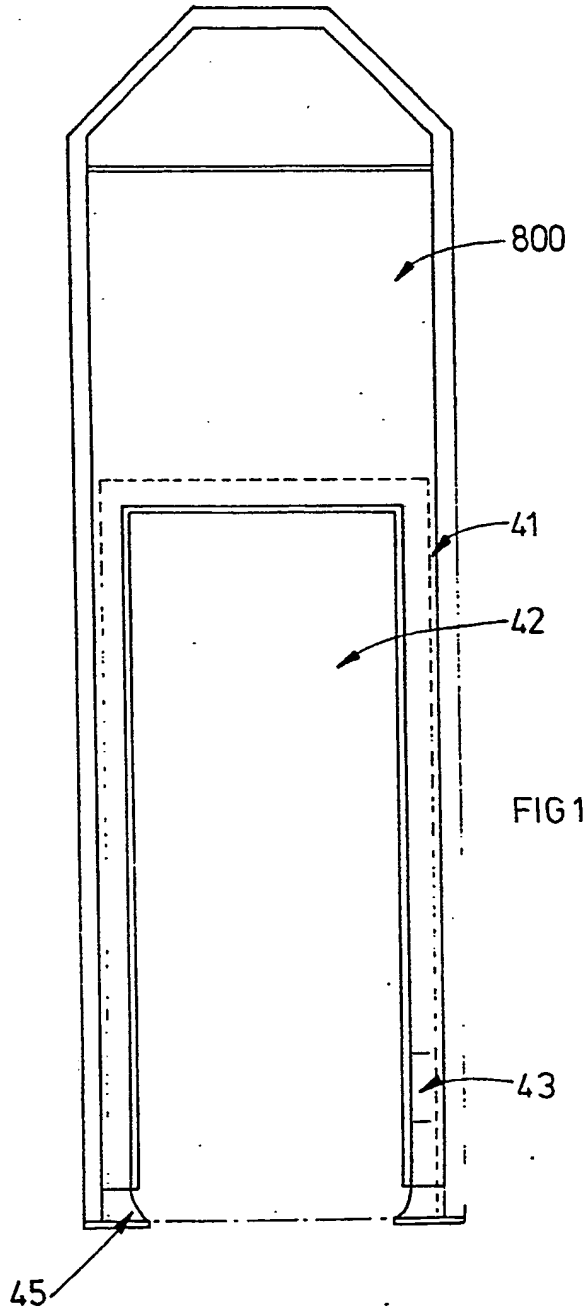

FIG 13A

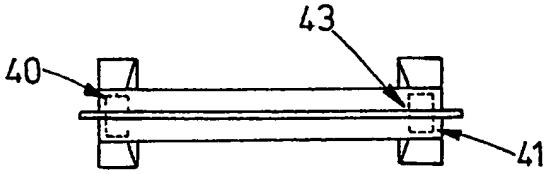

FIG 13 B

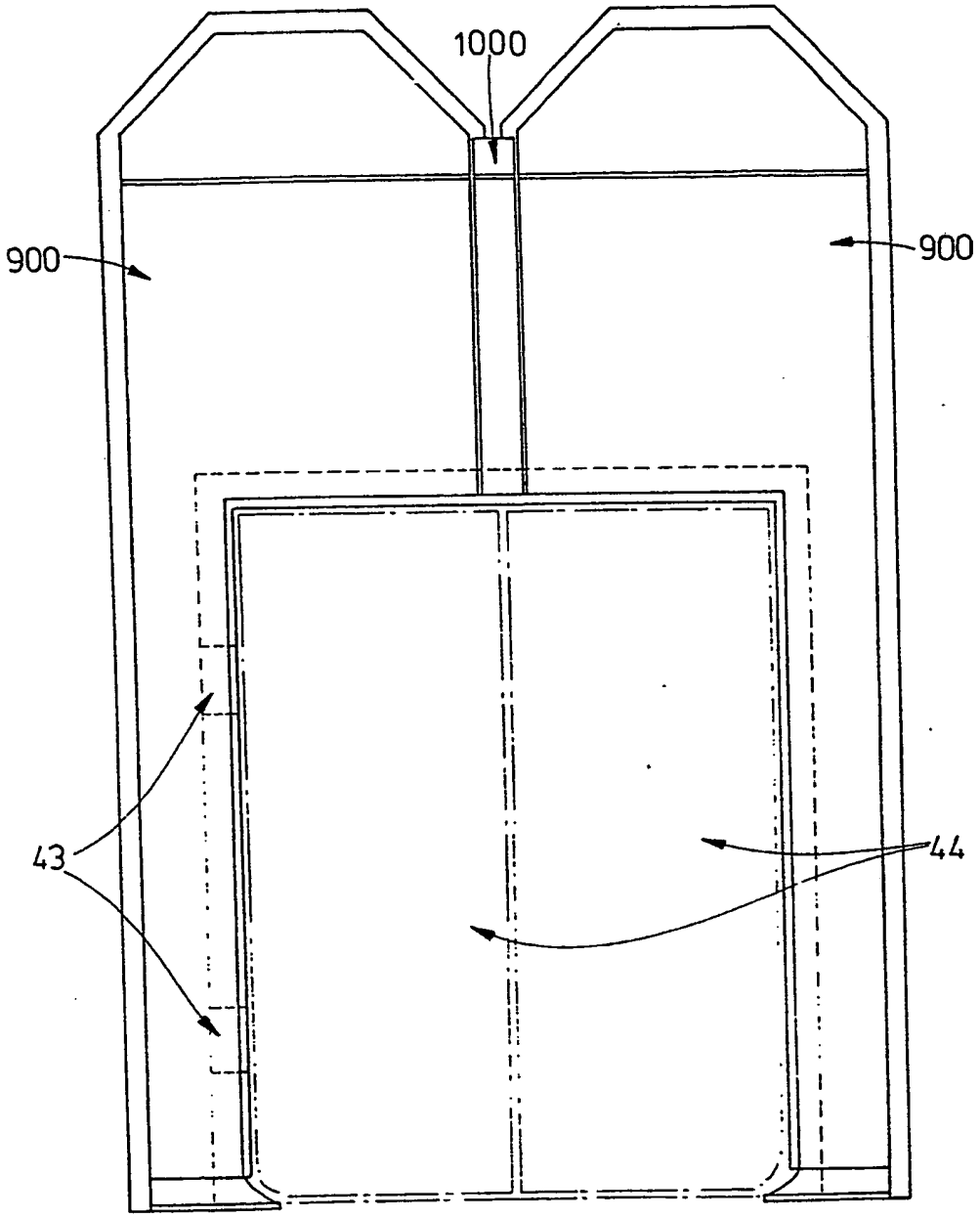

FIG 13C

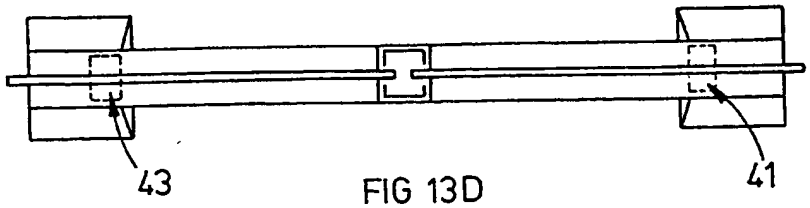

FIG 13D

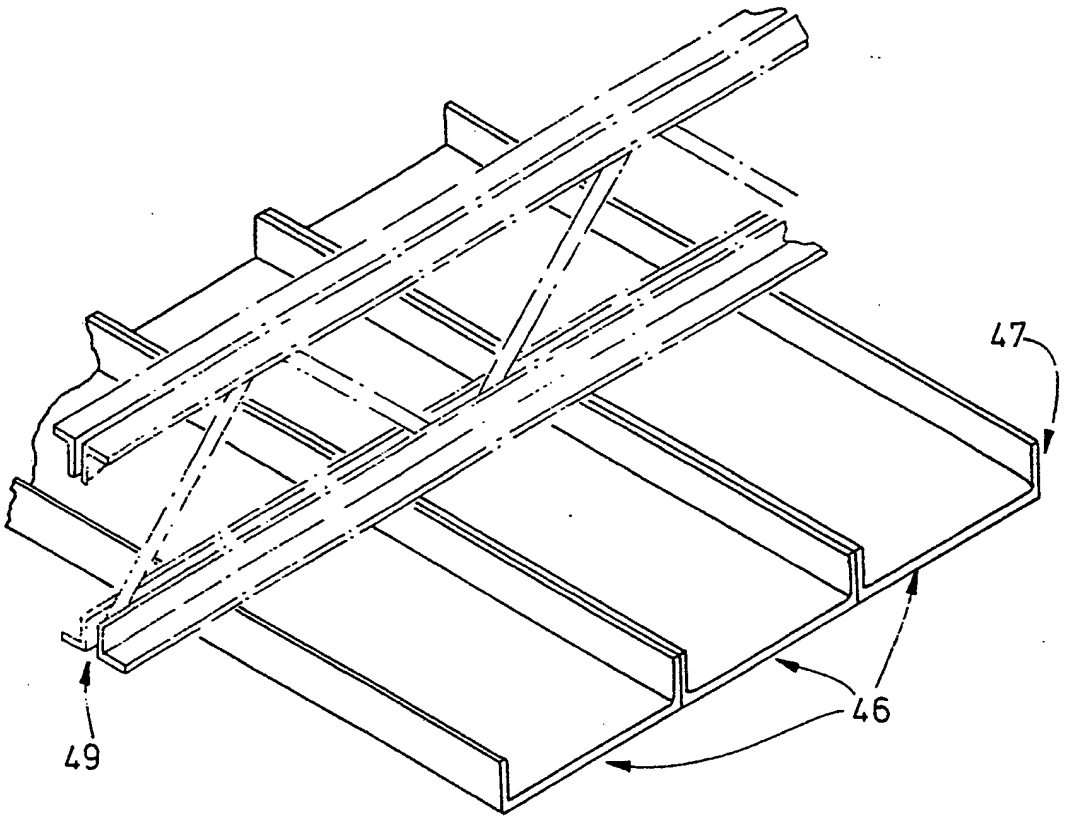

FIG 14

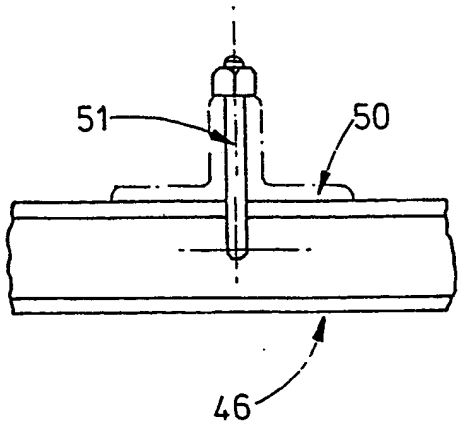

FIG 15A

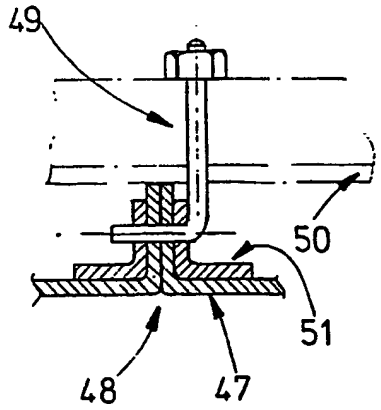

FIG 15 B

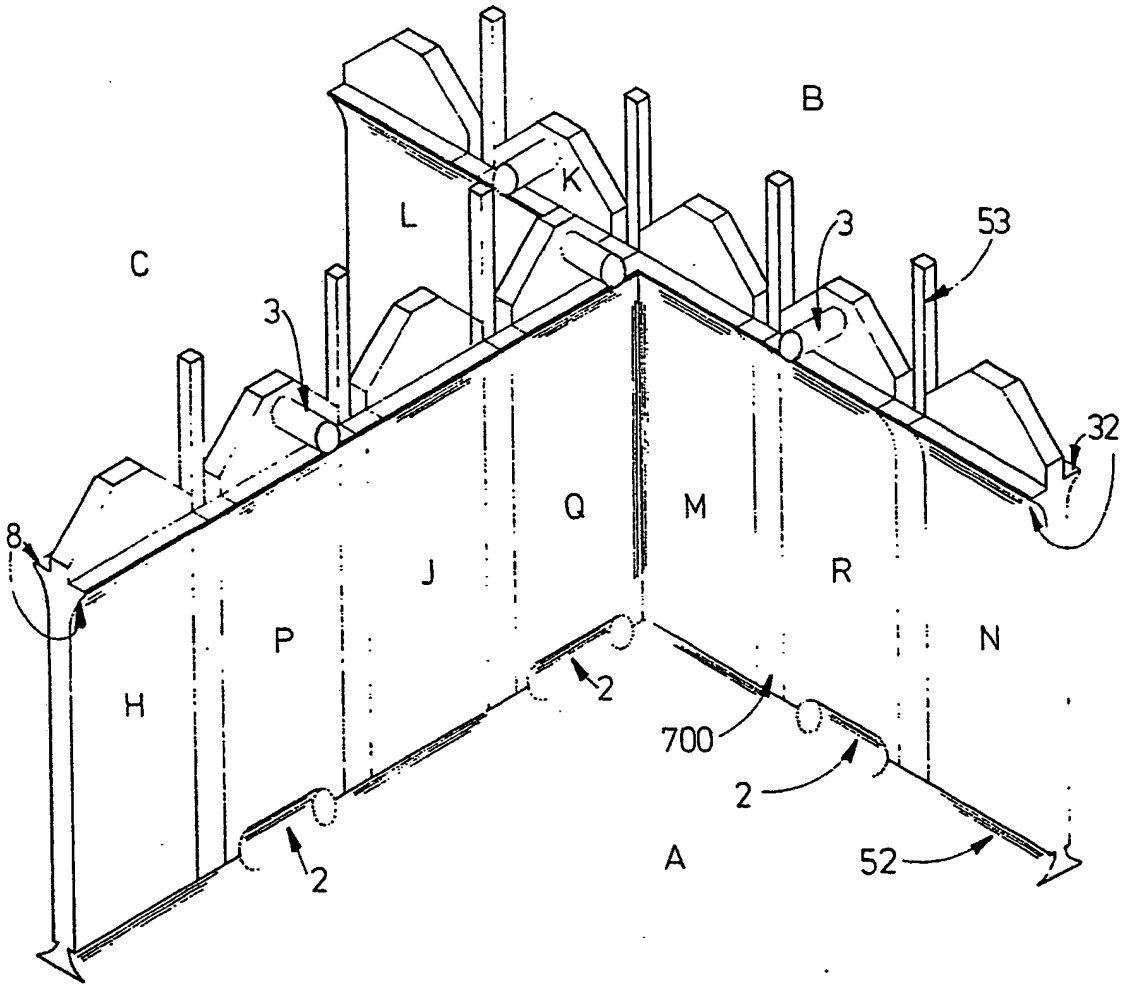

FIG 16

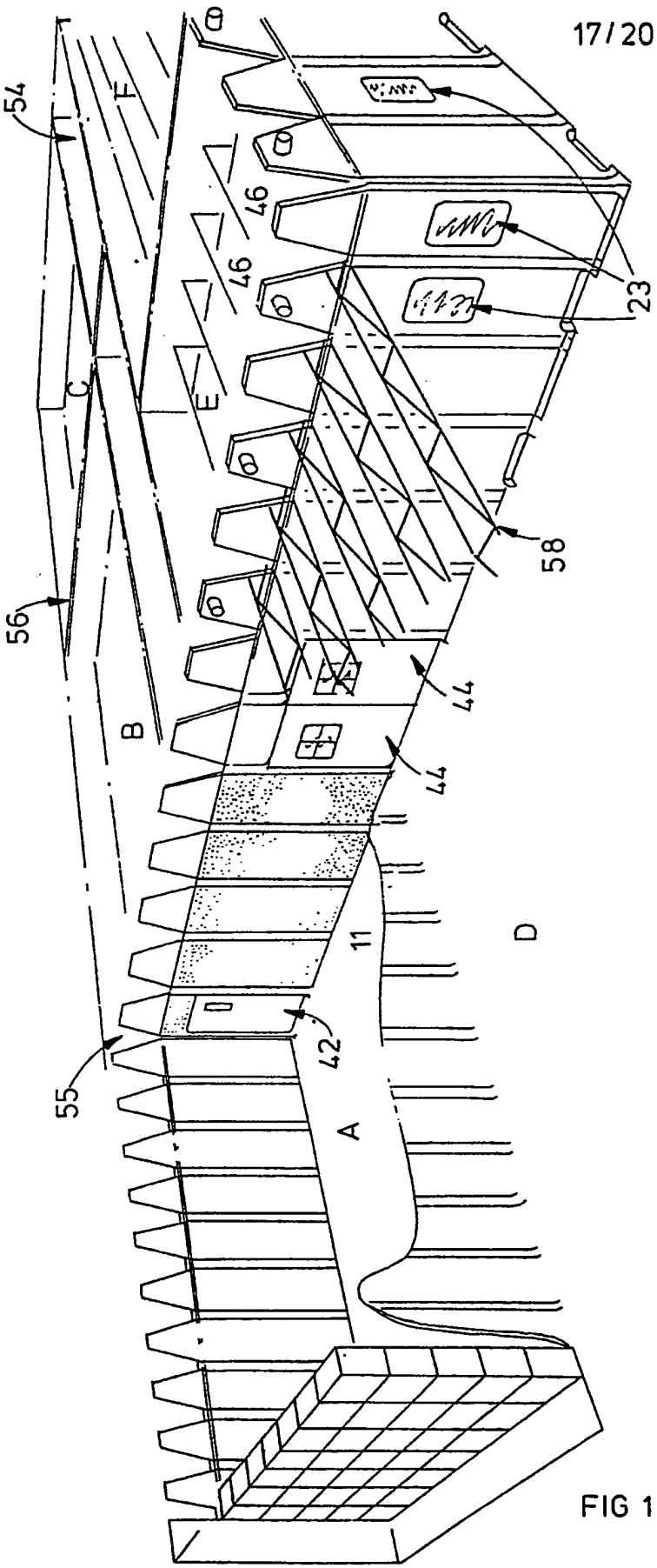

FIG 17

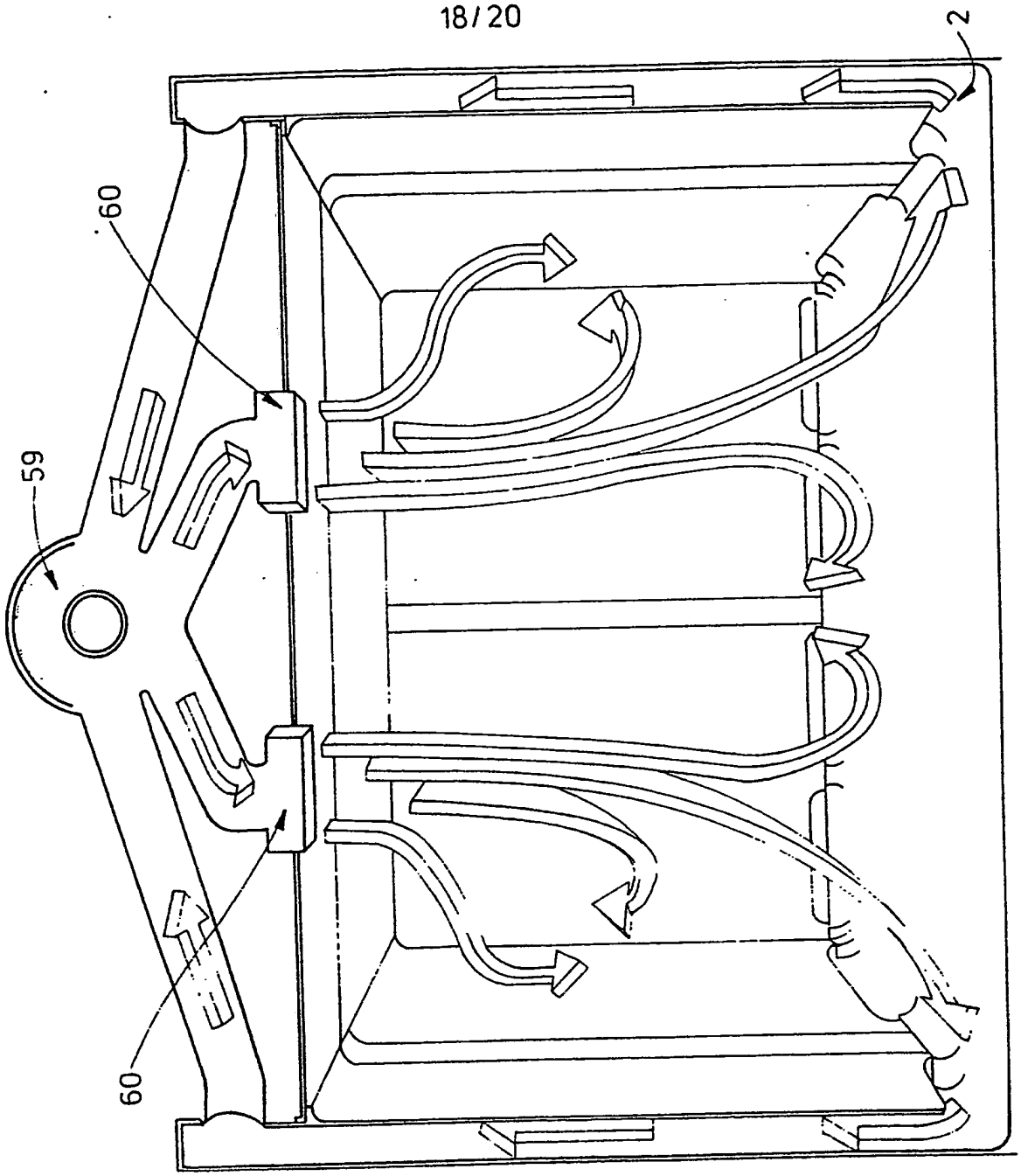

FIG 18A

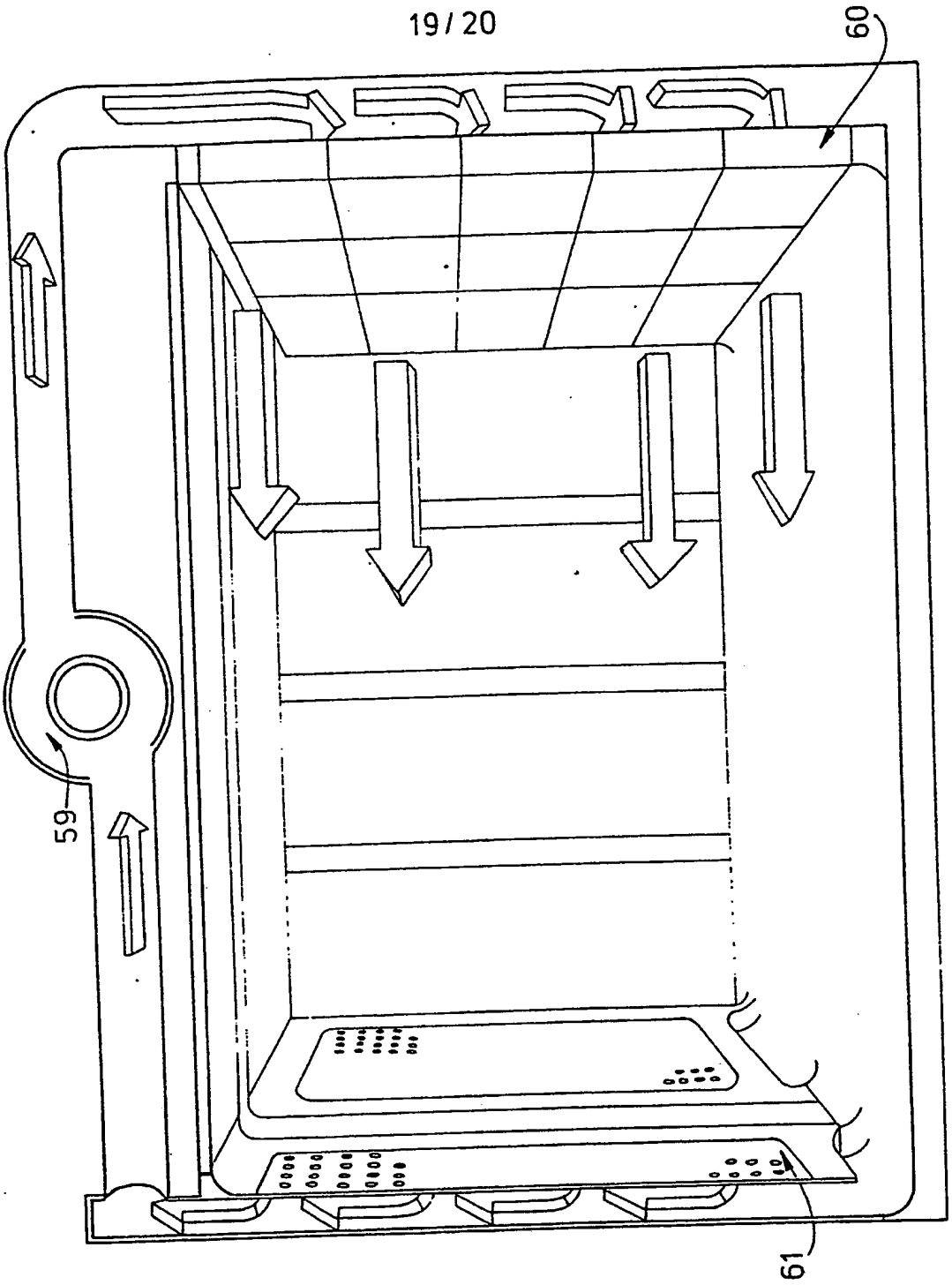

FIG 18B

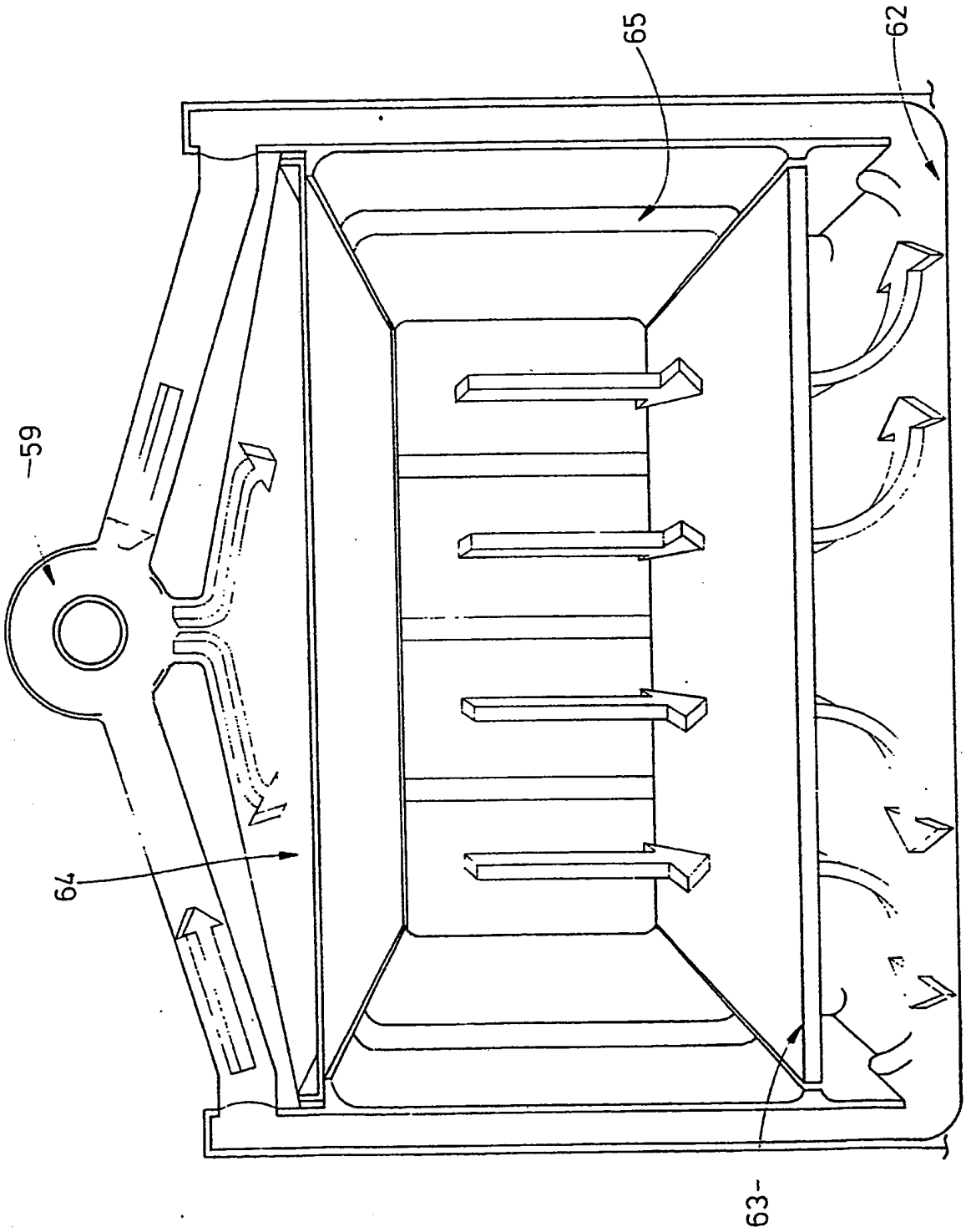

FIG 18C

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 82 30 2722

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	DE-A-1 912 020 (STRAMMAX AG.) * page 8, line 28 - page 10, first line; figures 15,16,17 *	1,3,5, 13	F 24 F 7/04 F 24 F 3/16 E 04 C 2/52
A	DE-A-2 856 074 (SCHUNK) * page 8, line 13 - page 9, line 23; figures 1,2,3,4,5 *	1,3,5	
A	DE-A-2 215 597 (JUERGENS) * page 3, lines 4-26; page 5, claim 1; figures 1,2,3 *	1,2,13	
A	SOLID STATE TECHNOLOGY: THE ELECTRONIC MANUFACTURER'S JOURNAL, vol.13, no.7, July 1970, Port Washington, N.Y. (US) C. ROTT: "Clean rooms", pages 35,36 * page 36, lines 9-15; figure 2 *	17	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-3 522 724 (KNAB)		F 24 F E 04 B E 04 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-09-1982	SARRE K.J.K.TH.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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